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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This ZIM-SCI study guide is a three-part unit consisting of activities and experiments in which students: (1) examine the nature, properties, and potability of water; (2) mix substances which produce solutions and suspensions; and (3) examine the solubility of substances and the rate at which they dissolve, prepare saturated solutions, and separate liquid mixtures. Information is provided throughout the unit to help students understand the scientific principles behind the activities and experiments. (JN)

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# ZIM–SCI

## ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

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SE 043 838

# STUDY GUIDE UNIT D

# What do you know about water?

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

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June, 1981

Zim - Sci

Zimbabwe Secondary School Science Project

GENERAL SCIENCE

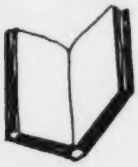
STUDENTS : Please read this carefully. It will help you.

How you will study

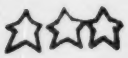
This study guide comes to you with a kit of apparatus. Both things are part of a study programme leading you to an understanding of aspects of science. In this course you will be carrying out experiments. The study guide will help you to understand the scientific principles behind the experiments.

Your work should be done as you are instructed, either by the teacher or the study guide.

To help you to see quickly what you must do, the study guide uses these symbols.



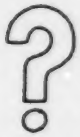
for "Read and revise your notes and Study Guide"



for "Take note of an important point that you should learn."

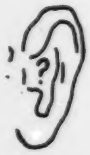
for "Summary". This is to help you to go over what you have learned.

for "Experiment".
When you see this sign, read the instructions carefully from beginning to end before you start to do the experiment.



for "How much do you know?"
This is for you, to help you to test whether you are remembering what is important.

for "Written work". This is when you must answer questions in writing.



for Listen to the teacher and do exactly what the teacher tells you to do

General Science

# UNIT D : WHAT DO YOU KNOW ABOUT WATER

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## AIMS OF THE UNIT

At the end of this Unit you will be able to :

1. List the factors affecting evaporation.

2. Draw a water cycle.

3. Describe how water is made safe to drink.

4. Describe how water is purified.

5. List factors affecting rate at which solutes dissolve in solvents.

6. Design experiments to make crystals.

7. Design experiments to separate a liquid mixture.

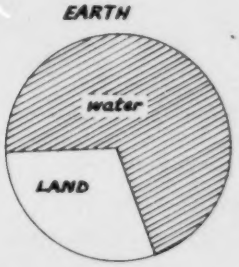
GENERAL SCIENCE UNIT D

## WHAT DO YOU KNOW ABOUT WATER?

### PART 1

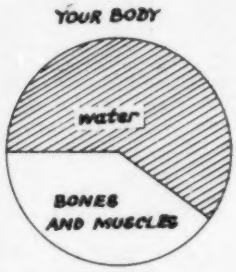
Water is something that is so common that you often do not feel its importance in your everyday life. Let us think about how important it is. Imagine the year when very little rain falls. What happens to the trees, the grass, the crops, your father's goats and cattle? All living organisms need water.

Did you know that 70% of the earth's surface is covered by water?




Plants contain 90% water.

Your body contains 60% water.




Musa lives in town and uses over 75 litres of water in a day. This is about fifteen buckets! You probably think this is a lot of water for one person. Each day he uses about 15 litres (3 buckets) of water for washing himself, 15 litres (3 buckets) for washing his clothes, 20 litres (4 buckets) for washing plates and cooking and at least 24 litres (5 buckets) for his garden!

How much water do you think you use in your daily life? More or less than Musa? Discuss this question with your teacher.

Industry also uses a lot of water in making things we need. For instance, you might be surprised to know that it takes about 190 litres of water to make the paper for 1 newspaper.

190 LITRES
(38 BUCKETS)

190 000 litres of water to make a motor car tyre.

Where does this water come from? The rains fill our lakes and rivers, but where does the rain come from? If you remember what you read in Unit B, you know that the heat from the sun is very important. It causes water to evaporate from the sea, rivers and lakes.

How do you think evaporation takes place and what makes water evaporate?

You noticed in Unit B that when an evaporating dish with water was placed in the sun, the water evaporated into the air. Does the particle theory help you to explain this? Well, you know that water is made of tiny particles which are always moving. These particles have a lot of kinetic energy. Some of them have enough energy to make them leave the surface of the water and mix with the air.

Imagine what happens when you wash your school uniform and put it out to dry. Normally, you do not dry your uniform under a tree do you? You would not, if you wished to dry it quickly, hang it out during the night.

Surely there must be a good reason for this. Think about the reasons.

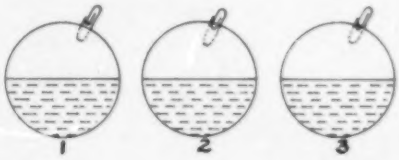
Let's try to investigate this in a scientific way.

EXPERIMENT 1 Drying Wet Papers

Your teacher will give you:

3 filter papers
3 paper clips
cotton thread
water

1. Number the filter papers 1, 2 and 3 and put your name on each paper with your pencil.
2. Then carefully fit each filter paper onto a clip. Your teacher will help you do this.
3. Now wet the bottom half of each filter paper with water. Do not wet the top half with the clip on it.




4. Hang filter paper No. 1 in your classroom away from the door or window.
5. Hang filter paper No. 2 in the sun outside your classroom.
6. Hang filter paper No. 3 in the shade outside your classroom.

Be careful to fix each paper clip tightly so that the paper does not drop. Then go back to your classroom.

While your filter papers are drying, wet both hands, keep one still and wave the other hand through the air feeling the wind. Which hand dries first?
Keep looking at your filter papers so that you may observe which dries first. Discuss what you observed with your partner.

When you have finished collect the clips and filter papers, fold them carefully and put them in your basic kit box. You will need them later.

From what you observed, which filter paper dried first, which dried next and which dried last?

Now you know why you do not normally wash your uniforms at night or dry them in the shade under a tree!

Experiment 1 has shown you that if the air is hot water evaporates quickly. The experiment also showed you that the water evaporated more quickly in a wind. The wind moved new air over the wet paper or wet hand. This means that if the air is not moving it cannot continue taking water vapour all the time. After some time the air becomes saturated with water vapour. 'Saturated' is a word you will meet very often in Science. You will probably meet it in Geography too. It simply means that the air is just 'full-up' with water vapour.

Now you are going to do an experiment with saturated air.

EXPERIMENT 2 Breathing on a Boiling Tin

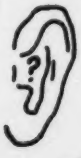
For this short experiment you will only need your boiling tin.

1. Hold the empty boiling tin in front of your mouth.
2. Then breathe out onto the boiling tin through your mouth.

What do you see on the surface of the tin?
Rub the surface of the tin with your finger.
Do you notice anything?

The surface of the tin was wet wasn't it? Why did you use the shiny surface of the boiling tin in this experiment? Discuss this with your friend. If you are not sure why you did it, hold the surface against your cheek. How does it feel? Does this give you an idea? If not, read on. Perhaps you have noticed what happens to the air you breathe out during a cold morning. You breathe out 'steam'. Does this mean water is boiling inside you? Not really, it simply means that the air you breathe out is saturated (full-up) with water vapour from your lungs. As you breathe the air out it is cooled outside your body. The water vapour you breathe out is cooled too. This then forms small drops of water which can be seen in the cold morning air outside your body. The water vapour has changed state from a gas to a liquid. (Remember Unit C2? ) Think about the boiling tin experiment. Now write down how water got onto the tin from your breath. (Exercise 1.)

How about the drops of water we often find on leaves of trees and grass during a cold morning? Where does this water come from? Where do clouds and mists come from? Where does rain come from? Think about these questions. Your teacher will discuss them with you.



After the discussion, do Exercise 2.

## DRINKING WATER

In the discussion with your teacher you talked about the water you drink and wash your clothes in, and how this water comes from clouds as rain. It is found in rivers, wells and some of it goes into the ground. If you live out in the country you most probably get your drinking water from a nearby well or river. Maybe your village is lucky enough to have a borehole. In the next experiment, you will look at some of the water from your area. Very often this water looks dirty. You will try to find out what makes it dirty.

### EXPERIMENT 3 Finding out what makes Water Dirty

You will need:

- 1 plastic bottle)
  1 funnel )
  2 plastic cups ) from your basic kit
  plastic beaker )
- 3 filter papers (from Experiment 1)
- your ruler
- a piece of white paper
- your pencil

Your teacher will give you:

- some clean water
- some dirty water

Use your plastic cups to collect the water.
Before you start the experiment copy the table your teacher has drawn on the blackboard into your exercise books.

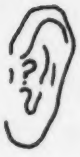
1. On a piece of white paper write the word 'CLEAN' with your pencil. Then stand an empty plastic bottle on the word and look into the bottle. Can you see 'CLEAN'? Good.

2. Now pour the dirty water into the bottle slowly. Look at the word 'CLEAN' each time you pour the water. Stop when the word just disappears.
3. Now measure the height of the water and record it in your table.

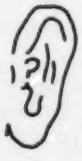
4. Filter this water into your plastic beaker (ask your teacher if you cannot remember how to filter things). Remove the filter paper. Use your hand lens to look at what is left on it. Describe its appearance in your table.

Clean the plastic bottle and then repeat steps 1 to 3 with the filtered water. Finally use the clean water in the same way. Write down all your results in the table. Remember to clean your plastic bottle each time!

As you saw, some water is clean, other water is dirty. Often the water from a river or a well is dirty. Where does this dirt come from? Discuss this with your teacher. Water containing dirt is not safe to drink. It has to be made safe to drink. Can you think of a way of making this water safe? You may have seen your mother using a sieve to remove dirt from water. Do you think this is a good way of doing this? Most probably not. This method will only remove large pieces of dirt. But as you saw, dirt may contain very small pieces. They would pass through the sieve quite easily. So removing dirt this way is not good enough. Can you think of a better method you could use yourself? I am sure you can. Discuss this question with your teacher.

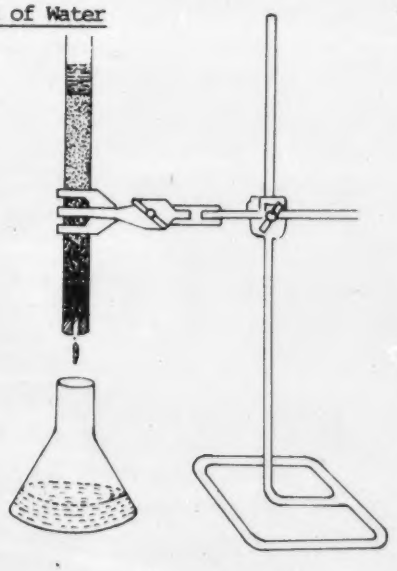


Do you think this method would be good for family use. You remember it was rather slow. Imagine how long it would take to filter all that water and the number of filter papers that you would use. Would everybody in your family get enough to drink this way? Are there other ways to clean water? Town water is safe to drink. How is it cleaned? Your teacher will show you another method which is used for cleaning water for people who live in towns.



EXPERIMENT 4 Cleaning a Lot of Water

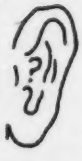
The diagram shows the things he will use in this experiment.

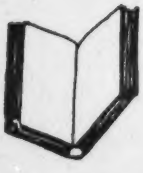


Did you think that was a good method of making water clean? You may have noticed that the method did not remove all the dirt from the water. In Unit A you saw some very small organisms which live in water. Since they are so small, they will not be removed by the cleaning methods you have learned about so far. Some of these organisms make people very ill if they drink water containing them. People call these harmful organisms 'germs'.

Don't drink water unless you are sure it is safe!

So these organisms must be removed before water is safe to drink. One way is to kill them by boiling the water. Perhaps your mother uses this method to make water safe for your family. Boiling would be a very expensive method to use for cleaning a lot of water because of the energy which would be needed. Your teacher will discuss with you how water is made very safe for people who live in towns.





You should now spend a lesson revising and re-reading the work that you have done in this unit.

So far you have seen that water contains small organisms, soil, pieces of leaves and grass. But are these the only things found in water? Are other substances found in it? You will now try to find this out.

EXPERIMENT 5 Warming some Water

You will need:

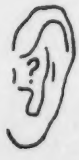
some water
your boiling tin
your burner and stand

1. Pour some water into your boiling tin until it is about half full.
2. Now heat the water. Observe what happens in the water as it gets warm.
3. Stop heating when the water is hot but not boiling.

When you have finished empty the tin and put away your apparatus. Answer Exercise 3.

What happened in the water as it warmed? Did you see small bubbles appearing on the side of your tin as the water got warm? Did you guess what these bubbles were? Isn't it surprising that water contains some air in it? This air is very important for small water animals like the ones you saw under the microscope in Unit A2. It is also important for fish.

So far you have seen that water contains small animals, pieces of plants and air. Are there any other substances in it which you could not see? How would you try to find out about this? Discuss this point with your friend, your teacher will probably be interested in joining your discussion.



EXPERIMENT 6 Finding out if anything is left when water evaporates

In this experiment you will need:

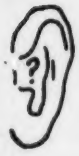
your dropper
your burner
your spatula
1 plastic bottle
3 microscope slides

Your teacher will give you some water from different sources, such as a well or a river.

1. Take your clean plastic bottle to your teacher and he will give you some water.
2. Now light your burner.
3. Using your dropper place two drops ofthis water on one of the slides. (Make sure your dropper is clean before you use it.)
4. Now hold the slide with the water above the flame.

5. Remove the slide as soon as all the water has evaporated. Place the slide on one side and let it cool.
6. Now empty your plastic bottle and shake it dry. Carry out steps 1 to 6 with the next sample of water. Remember to clean and dry your plastic bottle each time. Answer Exercise 4.

Was there anything left on any of the slides when the water evaporated? What was left on the slide is often called a residue, (something left behind). What did you think the residue was? Where do you think that substances dissolved in the water come from? Think carefully about this. Discuss it with your partner. Your teacher will be interested to know your answers.



PURE WATER

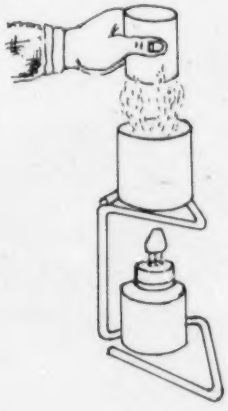
You have learned how to make water safe to drink. However, as you have seen, even safe water contains many substances. The water is not pure. Pure water is only water. It does not have any other substances in it. Sometimes scientists need pure water in their work. You will also need it in some of your science experiments in future. You will have to think of how to make water pure. Think about this now. If you find this problem difficult try holding your plastic cup in steam, maybe this will give you an idea!

EXPERIMENT 7 Holding a Plastic Cup in Steam.

You will need:

- a clean plastic cup
- your burner and stand
- some water
- boiling tin
- clean dropper
- microscope slide

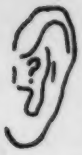
1. Fill your plastic bottle with water and pour nearly all this water into your boiling tin. Keep a few drops for later.
2. Light your burner and heat the water in the boiling tin until it begins to boil.
3. Hold a clean plastic cup in the steam.



Observe what happens on the surface of the cup. What is formed? Taste a few drops of this. Also taste the water left in the bottle. What do you notice?

You collected drops of water on the surface of the cup. This water formed when steam condensed on the cold surface of the cup. (Condensing is a word used by scientists to mean the change from gas to liquid.)

Using your microscope slide, collect a few drops of this water on the slide and evaporate as before over your burner. What do you find? Is there a residue?



Water collected by condensation is pure. The method you used to make this pure water is called distillation. The pure water is called distilled water. Can you collect enough pure water to fill your plastic bottle? Try to improve the, simple method we have shown you. Your teacher will help you to try out your ideas.

It would be a good idea to spend the next lesson on revision.

HOW MUCH DO YOU KNOW?

Complete the following sentences in your exercise books.

1. When a liquid changes into a vapour it is said to

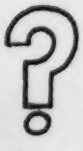
   ---

2. Evaporation takes place fast in ---------- air.

3. Evaporation takes place slowly in ---------- air.

4. When air can no longer hold any more water vapour it is

   said to be ----------



5. Drinking water at home can be made safe to drink by

   ---------- it.

6. In towns water is cleaned by ----------

7. When vapour changes into a liquid it is said to have

   ---

8. Water can be made pure by ----------

9. Pure water is called ---------- water.

PART 2

MIXTURES

In your everyday life you use a lot of mixtures. You make them too. Can you remember what a mixture is? You saw that the water you drink contains a lot of things. Is it a mixture? Listen to your teacher now and decide.

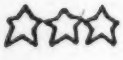
The tea you often drink is a mixture. Can you tell your teacher what things are mixed together to make tea? Tell him a lot of other mixtures that you know. He will write a list of these mixtures on the blackboard. Don't forget to tell him what things make the mixture. He will write these on the blackboard too.

From the list, you will see that some mixtures are made up of a solid dissolving in a liquid. Salt in water would be such a mixture. You made this mixture in Unit C.1.

The solid salt that dissolves is called a solute and in fact all substances which dissolve are solutes. The liquid that does the dissolving, like water in your experiment, is called a solvent.

If you like you can write the change like this:

solute + solvent = solution

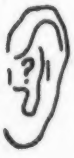


The salt is said to be SOLUBLE in water. A solute is SOLUBLE in a solvent.

You know from the particle theory you learned in Unit C.1 that salt is made of very small particles. In solid salt these particles come together to make crystals. But when salt is mixed with water the salt particles separate from each other and mix with water. The water helps them to separate. They DISSOLVE.

You have seen things dissolving and others melting. For instance, you saw naphthalene and candle wax melting. Does melting mean the same thing as dissolving? What different words describe dissolving and melting in Shona or Ndebele? Have you got the words? Anyway, no matter how hard you try

to think about the different words, you will discover that there are no separate words for dissolving and melting. You know that in science you have learned to use words with exact meanings. Melting and dissolving mean two different things in science. You saw what happened to the candle as it burnt (ask your teacher to light a candle if you cannot remember what you saw in Unit C2). The candle melted. This means that it changed from solid to liquid. This happens when most solids are heated. On the other hand, your salt simply dissolved in water. Two substances were used in this case (water and salt). The particles of one substance diffused and spread through the other substance without heating.



In your everyday experience you have seen many substances that dissolve in water and others that do not do so. Tell your teacher a few of the substances that dissolve in water and those that don't. He will make a list of these substances on the blackboard. How do you know when a substance has dissolved and when it hasn't? If your substance disappears in water completely leaving a clear solution then you are sure it has dissolved. If your mixture is not clear the substance has not dissolved. It has just spread through the water. It forms a cloudy mixture. Such a cloudy mixture is called a suspension.

An important point to note here is that a solution may be COLOURED. Remember your potassium manganate solution, or your copper sulphate solution? Both of these were coloured. They were not cloudy, so they could not be called suspensions! Don't forget that true solutions might have some colour.

Now that you are able to recognise a true solution, your teacher will give you some substances for you to try to dissolve in water.

## EXPERIMENT 8 Dissolving Substances in Water

You will need:

*your plastic bottle and lid*
some water
some chemicals (from your teacher)

Before you start, copy the table your teacher has drawn on the blackboard into your exercise books. When you have done this you are ready to start doing the experiment.

1. In your plastic bottle, collect 1 spatula sodium carbonate from your teacher.
2. Pour some water into the plastic bottle until it is half full.
3. Screw the cap on the bottle and shake. Observe what happens. Record what you observed in your table.
4. Throw away the mixture and clean your bottle.

Repeat steps 1 to 4 with calcium chloride, sulphur and naphthalene. Record what you observe for each substance as you did for sodium carbonate.

You were probably surprised that some substances dissolve in water and others don't. Why do you think this happens? Not an easy question is it? Think about it - your teacher will help you.

Water dissolves many substances, but is it the only solvent there is? Some of the substances you tried did not dissolve in water. They are insolubles in water. You will now try dissolving them in another solvent. Your teacher will discuss possible solvents with you.

**EXPERIMENT 9** Dissolving Things in Methylated Spirits

You will need:

your plastic bottle and lid

Your teacher will give you:

1 spatula full of the same substances that you used in Experiment 8
some methylated spirits

Carry out this experiment exactly as you did in Experiment 8 using methylated spirits instead of water. Make a table of your observations.

**HOW MUCH DO YOU KNOW?**

In your exercise book complete the following sentences:

1. A mixture which is clear and the same throughout is called a ----------

2. A substance that dissolves is called a ----------

3. The substance that does the dissolving is called a ----------

4. Solute plus solvent gives a ----------

5. A mixture of a solute and solvent that does not form a clear solution is called a ----------

PART 3

HOW MUCH DISSOLVES?

When you dissolved substances in water, did you think about how much of the substance dissolved? Can water continue dissolving more and more solute, or does the water become 'full-up' with solute, like air becomes' full-up' with water vapour in the experiments on evaporation? Does it become saturated? You can investigate this now.

EXPERIMENT 10 To Investigate how much Copper Sulphate Dissolves in Cold Water

You will need:

- your 5ml measure
- plastic bottle
- graduated beaker
- some water

Your teacher will give you some copper sulphate. Use your beaker to collect it.

1. Pour $10cm^3$ of water into your plastic bottle.
2. Then put a spatula full of copper sulphate into the water, close the bottle and shake until all the copper sulphate dissolves.
3. Add another spatula full and shake again. Continue adding copper culphate, shaking each time. Observe what happens to the copper sulphate as you continue adding it to the water. Count how many spatulas of copper sulphate dissolve completely.

Fill in the first part of Exercise 5.

What did you find out about the mixture? Did the copper sulphate continue to dissolve? If not, how many spatulas full did you add before the copper sulphate stopped dissolving?

A solution in which no more solute will dissolve is called a saturated solution. This time your solution is 'full-up' with solute. The extra copper sulphate just lay at the bottom of the bottle. It could not dissolve any more. You counted the number of spatulas full of copper sulphate that dissolved in water, so you know how much copper sulphate dissolved in $10cm^3$ of cold water. How much of it will dissolve in the same volume of hot water? Can you investigate this?

EXPERIMENT 11 Dissolving some Copper Sulphate in Hot Water

You will need:

your plastic bottle )
beaker containing copper sulphate ) from Experiment 10
spatula )
some water )

boiling tin

burner and stand

peg

1. Pour some water into your boiling tin. Light your burner and heat this water.
2. When the water is hot to touch hang the bottle of solution in the water using your peg. Watch what happens as the solution heats up.
3. When the water in the boiling tin is boiling, remove the bottle, cap it and shake it. What happens to the undissolved crystals? Can this hot solution dissolve any more copper sulphate? Add some more spatulas full as you did for Experiment 10, and complete Exercise 5. Keep this saturated solution for use later.

How many spatulas full of copper sulphate formed a saturated solution this time? Can you say hot water dissolves more copper sulphate than cold water? Usually, more solute dissolves in a hot solvent than in a cold one. If you took a different solute, would you get the same results as you got for copper sulphate?

Try dissolving a different substance in $10cm^3$ of cold water now.

EXPERIMENT 12 Dissolving Salt in $10cm^3$ of Cold Water

You will need:

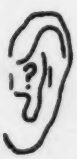
1 plastic bottle
5ml measure
some water
graduated beaker

Your teacher will give you some sodium chloride in your beaker.

1. Pour $10cm^3$ of cold water into the bottle.
2. Now add spatulas full of sodium chloride to the water as you did before.
   Record your results in Exercise 6.

Throw away the solution, clean your bottle and dry it. Return the rest of the sodium chloride to your teacher.

Compare your results from Exercise 5 (Part 1) and Exercise 6. Did the water dissolve more copper sulphate than salt, or less copper sulphate than salt? Were they the same? Can you explain this behaviour of substances using the particle theory you learnt about in Unit C2? If you find this difficult, your teacher will discuss this question with you.



In science, as you know, we like to be able to measure things accurately. In your experiments you used a 'spatula full' as your unit. Perhaps you noticed that not all the spatulas in your class hold the same amount. So, using spatulas will not give you a very accurate measurement.

Your teacher will discuss with you the most common method of more accurate measurement.

## WHAT MAKES SUBSTANCES DISSOLVE FAST?

You have ofter seen people stirring their tea after adding some sugar. You have done it, too,when you dissolved dyestuff in Unit C1. Can you remember why you should stir? You can do an experiment now to compare a stirred solution with an unstirred one.

### EXPERIMENT 13 Stirring some Sugar in Water

You will need:

2 clean plastic bottles (clean them well if they look dirty
your 5ml measure

Your teacher will put two spatulas full of sugar in each.

Take the bottles to his table for him to do this.

1. Pour $10cm^3$ of clean water into each bottle, using your measure.
2. One bottle must be left alone while you stir the mixture in the other with your spatula (make sure the spatula is clean before you use it). Stir well.

Now compare the amount of undissolved sugar in both bottles. Taste the two solutions.

Which solution tasted sweeter? Did you think stirring made any difference? Your teacher will discuss this point with you further. Now you have seen the effect of stirring a mixture? Is there any other way of making substances dissolve quicker? Can you think of other ways of making substances dissolve quicker? Discuss this with your teacher, and answer Exercise 7.

It would be a good idea to spend the next lesson on revision.

## SATURATED SOLUTIONS

What happens when a hot saturated solution cools? First you will look at a saturated solution of alum.

### EXPERIMENT 14 Looking at a Saturated Solution

You will need:

2 filter papers
burner and stand
your hand lens
your micromount
2 plastic bottles
some water
boiling tin

Your teacher will give you some alum crystals.

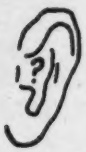
1. Pour some water into your boiling tin until it is about half full. Heat the water until it is about to boil.
2. Pour some of this water into one plastic bottle until it is half full.
3. Then add some alum to the hot water until you get a saturated solution. How will you know when it is saturated?
4. Carefully pour the clear hot solution into the other plastic bottle. (Be careful not to pour some of the undissolved solid as well.)
5. Put a drop of this hot solution on a micromount. It will cool very quickly. (Your teacher will show you how to make such a slide.) Keep the rest of the solution and let it cool slowly. You will look at it later.

6. Look at the drop under your bioviewer. You will probably need to watch for some time to see anything happening.

Your teacher will also show you what happens in a drop using his microscope.

Repeat the observation with the copper sulphate solution that your teacher has been keeping for you.

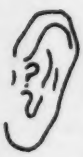
Now answer Exercise 8.



What formed in the drops of solution? Nice crystals! Did you see their shape clearly? Were they the same shape?

When you have finished drawing the crystals look at the solutions in the plastic bottles. More crystals have formed, they are larger this time!

Now carefully pour away the clear solution from each bottle. Be careful not to lose your crystals. Put the crystals on the filter papers. Pick one crystal of alum and one of copper sulphate. Look at each using your hand lens. Do they look like the ones you drew? Keep the rest of the crystals for the next experiment. Clean your plastic bottles. When you have finished cleaning answer Exercise 9 in your books.



Now you have seen enough crystal shapes to be able to tell your teacher what crystals look like. Are they all the same shape? Are they all the same size? From what you have seen, crystals of copper sulphate differ from crystals of alum. As crystals grew from each solution they got larger and larger and yet kept the same shape all the time. You noticed if you looked very carefully that all the crystals you saw had flat faces, straight edges and corners. These are characteristics of <u>all</u> crystals. What made the copper sulphate and alum crystals different? Discuss this with your teacher. You can now use your knowledge about how crystals are formed to produce larger ones. Discuss how to do this with your partner before you read on.

## EXPERIMENT 15 Producing Large Crystals

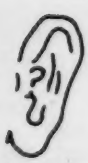
You will need:

your plastic bottle
some hot water
a used match stick
alum crystals from Experiment 14
some thread

1. Pick up one good alum crystal from those you made in Experiment 14. Have you found it? Good.
2. Tie this crystal with one end of the thread carefully so that it cannot drop.
3. Tie the other end of the thread on to a used match stick.
4. Using the rest of the alum crystals make a saturated solution in the plastic bottle. Let it cool.
5. Now place the crystal in the cold saturated alum solution so that it hangs as shown

Can you think of a reason for using a cold saturated solution of alum? Why not use a hot solution? Why use a saturated solution?

Carefully lift the bottle and place it at the back of your classroom where it will not be disturbed. Keep it there for about a week. Look at the crystal daily. It should grow large.



Your teacher will give you some biostrips of some crystals found in nature. Use your bioviewer to look at these. Try to find some of these crystals to keep in your classroom. Your teacher will be very pleased with you if you do this.

## MIXTURE OF LIQUIDS

In the experiments you have been doing so far you looked at mixtures of solids and liquids. Do you think liquids might form solutions with other liquids? Think back to Unit C2. Which experiment in that unit indicated that this might happen? Discuss this with your teacher. You will try another mixture now.

### EXPERIMENT 16 Mixing Water with Glycerine

You will need:

- 2ml measure
- 1 plastic bottle
- some water

Your teacher will give you some glycerine. Collect this with your 2ml measure.

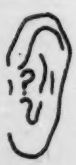
1. Pour some water in your plastic bottle until it is half full.
2. Now pour all the glycerine into the water. Look at the mixture and shake if necessary.

Throw away the mixture when you have finished and wash your apparatus.

Was the mixture clear? Was a solution formed? Your teacher will talk to you about other liquid mixtures.

## SEPARATING MIXTURES OF LIQUIDS

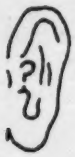
You have already separated a salt and water mixture in Unit C1. Do you remember how you did this? Liquid solutions cannot be separated this way. What can we do?



Your teacher has made a mixture of water and methylated spirits. Think carefully about how to separate them. It may not be easy to do. Discuss this with your teacher.

Now answer Exercise 10.

In the last experiment you collected methylated spirits as it came out of the glass tube. Why didn't the water distil over at the same time as well? Think carefully about this important question with your partner. Your teacher will discuss your answers with the whole class.



In the next Unit you will be looking at the way in which living things are made. You will find that water and solutions play a very important part.

Please revise this Unit thoroughly before you go on to Unit E.

SUMMARY

PART 1

Evaporation occurs when particles have enough kinetic energy to leave the liquid and occupy the space above the liquid in the form of a gas. Evaporation takes place fast in dry air, in moving air and in hot air. It is slow in cold, moist air which is not moving fast.

When air can no longer hold any more water vapour it is said to be saturated.

Water often contains pieces of dirt and needs to be cleaned for drinking. Most of the dirt can be removed by filtration. Drinking water at home can be made safe to drink by boiling it. In towns, drinking water is cleaned by filtration. Chemicals are used to kill organisms.

When liquid changes into a vapour it is said to have evaporated.

When vapour changes into a liquid it is said to have condensed.

Water can be made pure by distillation.

Pure water is called distilled water.

PART 2

A mixture which clear and the same throughout is called a solution.

A substance that dissolves is called a solute.

The substance that does the dissolving is called a solvent.

Solute plus solvent gives a solution.

A mixture of a solute and solvent that does not form a clear solution is called a suspension.

PART 3

A solution in which no more solute will dissolve is called a saturated solution.

Usually, more solute dissolves in a hot solvent than in a cold one.

Stirring makes solutes dissolve fast.

Crystals of one substance differ in shape from those of another substance.

All crystals have flat faces, straight edges and corners.